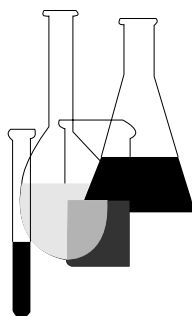




Spray Drift Test Guidelines

OPPTS 840.1100 Spray Droplet Size Spectrum



INTRODUCTION

This guideline is one of a series of test guidelines that have been developed by the Office of Prevention, Pesticides and Toxic Substances, United States Environmental Protection Agency for use in the testing of pesticides and toxic substances, and the development of test data that must be submitted to the Agency for review under Federal regulations.

The Office of Prevention, Pesticides and Toxic Substances (OPPTS) has developed this guideline through a process of harmonization that blended the testing guidance and requirements that existed in the Office of Pollution Prevention and Toxics (OPPT) and appeared in Title 40, Chapter I, Subchapter R of the Code of Federal Regulations (CFR), the Office of Pesticide Programs (OPP) which appeared in publications of the National Technical Information Service (NTIS) and the guidelines published by the Organization for Economic Cooperation and Development (OECD).

The purpose of harmonizing these guidelines into a single set of OPPTS guidelines is to minimize variations among the testing procedures that must be performed to meet the data requirements of the U. S. Environmental Protection Agency under the Toxic Substances Control Act (15 U.S.C. 2601) and the Federal Insecticide, Fungicide and Rodenticide Act (7 U.S.C. 136, *et seq.*).

Final Guideline Release: This guideline is available from the U.S. Government Printing Office, Washington, DC 20402 on *The Federal Bulletin Board*. By modem dial 202-512-1387, telnet and ftp: fedbbs.access.gpo.gov (IP 162.140.64.19), or call 202-512-0132 for disks or paper copies. This guideline is also available electronically in ASCII and PDF (portable document format) from the EPA's World Wide Web site (<http://www.epa.gov/epahome/research.htm>) under the heading "Researchers and Scientists/Test Methods and Guidelines/OPPTS Harmonized Test Guidelines."

OPPTS 840.1100 Spray droplet size spectrum.

(a) **Scope—(1) Applicability.** This guideline is intended to meet testing requirements of both the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)(7 U.S.C. 136, *et seq.*) and the Toxic Substances Control Act(TSCA)(15 U.S.C. 2601).

(2) **Background.** The source material used in developing this harmonized OPPTS test guideline is the OPP guideline 201-1—Droplet size spectrum testing (Pesticide Assessment Guideline, Subdivision R: Pesticide Spray Drift Evaluation, EPA Report 540/9-84-002, April 1984).

(b) **General—(1) Purpose.** Droplet size spectrum studies are performed to determine the influence of a number of equipment and formulation parameters and initial environmental factors on the formation of the droplets as they leave the pesticide dispersal equipment. The major parameters that will be tested are type of nozzle, orientation to the wind shear, and formulations. By studying this part of the application process in detail, the more expensive field evaluations will have to be performed less frequently. Droplet size studies indicate which of the conventionally used nozzle types, orifice sizes, operating conditions, adjuvants, formulations, and discharge orientations would produce the greatest volume of droplets less than 100 microns in diameter. Droplet size spectrum studies may be carried out in wind tunnels or during the field evaluation of drift using commercial equipment.

(2) **Test standards.** In addition to those test standards set forth in OPPTS guideline 840.1000, the following standards apply:

(i) **Test substance.** A formulated end-use product of the same formulation category as the end-use product to be registered, i.e. wettable powders, emulsifiable concentrates, etc., and use, i.e. herbicide, insecticide, etc., will be tested.

(ii) **Equipment.** The label-recommended or commonly-used nozzles and associated parts, nozzle pressures, and nozzle discharge orientation that would produce droplets that would be most conducive to spray drift should be tested.

(iii) **Meteorological conditions.** (A) For wind tunnel studies, the following conditions should be tested:

(1) The product should be tested at various temperature levels from 10 to 35 °C.

(2) The air flow (velocity) in the wind tunnel may be adjusted to relate to the type of equipment used (e.g. 130 to 225 kmph (80 to 140 mph)) for fixed-winged aircraft and air carriers, 65 to 110 kmph (40 to 70 mph) for helicopter (rotary-winged aircraft), and 5 to 40 kmph (3 to

25 mph) for ground applications (including sprinkler irrigation) other than air carriers (mist blowers).

(B) For field determination studies, the meteorological conditions should be those most conducive to spray drift (relatively high temperature, low relative humidity, and inversion). Field studies with the elevated temperatures are conducted to determine the effect of a higher evaporation rate on the droplets.

(iv) **Collection devices.** The collection devices should be either laser particle measuring systems, collection cards (both horizontal or vertical surfaces), air samplers, or other devices by which droplet size distribution can be determined.

(c) **Data reporting.** The registrant's report on droplet size spectrum studies should include all information necessary to provide: A complete and accurate description of the treatments and procedures; sampling data; data on storage of the samples until analysis (if performed); any chemical analysis of the collection surfaces as to chemical content (if performed); recovery efficiency; reporting of the data, rating system and statistical analysis; and quality control measures/precautions taken to ensure the fidelity of the operations. Specifically, each report should include the following information:

(1) **General.** (i) Cooperator or researcher (name and address), test location (county and state; country, if outside of the U.S.A.), and date of study;

(ii) Name (and signature), title, organization, address and telephone number of persons responsible for planning/supervising/monitoring.

(iii) Trial identification number.

(iv) Quality assurance indicating: control measures/precautions followed to ensure the fidelity of the droplet size; record-keeping procedures and availability of logbooks; skill of the laboratory personnel; equipment status of the laboratory; degree of adherence to good laboratory practices; and degree of adherence to good agricultural practices for application of pesticides.

(v) Other information the registrant considers appropriate and relevant to provide a complete and thorough description of the test procedure and results.

(2) **Control data.** Control values for the test should be reported. Due to the wide diversity of pesticide properties, use patterns, and organisms exposed in the field environment, specific reporting requirements for control values (as to source, sampling regime, and total number of sample data submitted) will depend upon the complexity and variability of the environment in which the test is to be conducted.

(3) **Test substance and physical properties.** (i) Identification of the pesticide active ingredient including chemical name, common name (ANSI, BSI, ISO, WSSA), and company developmental/experimental name.

(ii) Active ingredient percentage by weight in the formulated end-use product used or substituted (with reasons for substitution of end-use product).

(iii) Type of formulation (e.g., emulsifiable concentrate, flowable powder, liquid, etc.). Product formulation used, diluent and manner of dilution, mixtures, adjuvants, and their physical properties (surface tension, viscosity, density, vapor pressure, etc.).

(iv) Dosage of active ingredients or acid equivalent per unit area of land or gallons-per-minute (gpm) or liters-per-minute (lpm). The concentration of the final diluted spray mixture (in the spray tank) should be sampled, chemically analyzed, and reported.

(v) If droplet size distribution is determined during the field evaluation, physical property data, including droplet size, viscosity, density, vapor pressure, visco-elasticity, and surface tension, should be determined and reported.

(4) **Test method.** Each report should contain a statement regarding the method of droplet testing used (wind tunnel, aircraft, mist blower) including a full description of the experimental design and procedure. In lieu of the wind tunnel study required for this test, droplet size distribution may be determined under field conditions during the spray drift evaluation test as provided in OPPTS 840.1200.

(5) **Collection surfaces.** (i) Identification of the collection surfaces. The collection surfaces may include laser particle measuring systems (PMS), collection cards (flat horizontal or vertical surfaces), air samplers or other devices by which droplet size distribution can be measured;

(ii) Identification of the number of replicates.

(iii) Distance between nozzles and collection surface/detection device.

(6) **Site of the test.** (i) Type of site of the droplet size spectrum study as to whether the study was performed in or out of a wind tunnel or in the field during the drift field evaluation study.

(ii) Climatological data (records of applicable conditions for the type of site, i.e., temperature, air flow or velocity, wind direction [field study], relative humidity).

(7) **Application equipment.** (i) The nozzle type, orifice size, and core identification.

(ii) The nozzle pressure and flow rate.

(iii) The nozzle discharge orientation to the airstream. Nozzle discharge orientation should be designated in degrees related to the direction of travel of the spray equipment. Zero degrees indicates a horizontal nozzle discharge pointing rearward (opposite to the equipment direction of travel), 90° indicates a vertical nozzle discharge pointing downward, and 180° indicates a horizontal nozzle discharge pointing forward (with the equipment direction of travel).

(iv) The estimated minimum and maximum nozzle-to-target height.

(v) Air velocity past the nozzle.

(vi) Descriptions of techniques and size determination devices.

(vii) Particle size distribution vs. cumulative percent volume and particle size distribution vs. droplet number (frequency) (an attempt should be made to determine the droplet size distribution where droplet formation is finalized).

(8) **Additional information.** If droplet size distribution is determined during the field evaluation, the following information should also be submitted:

(i) A diagram of the plot indicating north, swath width, and orientation, and location and spacing of the collection stations.

(ii) Temperature at two levels, wind velocity and direction, variations in velocity and direction during the application, relative humidity, atmospheric pressure, and air stability. The latter is expressed as Barad's stability ratio:

$$SR = [(T_3 \text{ meters} - T_1 \text{ meters}) / (\text{ave. wind velocity})] \times 10^5$$

Temperature should be determined just above the canopy (T_1) and at least 2 m above that (T_3) for all applications. A standard vertical separation should be 2 m. Wind velocity should be determined at least 1 to 2 m above the canopy height.

(iii) Spray volume (liters per hectare or gallons per acre) and carrier(s). The maximum and minimum carrier volumes recommended on the label should be reported.

(iv) The ground speed of application equipment, the number of swaths sprayed during exposure of collecting surfaces, and swath width.

(v) The quantity of active ingredients(s) or acid equivalent collected or detected at each sampling point in terms of kilograms per hectare (pounds per acre).

(9) **Results.** (i) The particle size distribution versus cumulative percent volume and versus droplet number (frequency) should be reported.

(ii) The 10th, 50th and 90th percentile of the size distributions with respect to droplet volume and number and standard deviations, where possible, should be reported.

(d) In lieu of the wind tunnel study required by this section, droplet size distribution may be determined under field conditions during the spray drift evaluation test as provided in OPPTS 840.1200.